

AD 683042

TRANSLATION NO. 2376

DATE: Jan 1969

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AD 683042

UDC 614.48(47)(091.)

## ACHIEVEMENTS OF SOVIET DISINFECTION\*

Following is a translation of an article by V.I. Vashkov from the Russian-language periodical Zhurnal Mikrobiologii Epidemiologii i Immunobiologii (Journal of Microbiology, Epidemiology and Immunobiology), No : 9, Moscow, September 1967, pages 7-137.

Following the Great October Socialistic Revolution, the most ample possibilities for scientific and cultural development opened in our country. Great successes have been attained in the fields of physics, mathematics, chemistry and biology. There have also been significant achievements in medicine.

In Tsarist Russia, due to the low living standard of the overwhelming majority of the population, as well as the absence of a widely developed network of medical, including sanitary, institutions, the incidence of infectious diseases constituted over 20% of all disease in the population and often assumed epidemic proportions. Hence, according to official data, the total number of persons suffering from typhus, smallpox, scarlet fever, diphtheria, measles and dysentery was 645,444 in 1882. It should be borne in mind that the largest proportion of infectious cases were generally not registered. The mortality in 1908-1913 reached 28.4 persons per 1000 in the population. Nonetheless, the high morbidity and mortality rate in the population hardly disturbed the Tsarist government. Measures to control

\*This article basically treats problems of disinfection; a separate article is devoted to disinsectization and rat eradication.

epidemic diseases, such as quarantines, the organization of antiepidemic detachments, were sporadically introduced at the time that epidemics of especially dangerous diseases arose.

The sanitary and antiepidemic service, accompanied by sanitation in Russia, developed only during the last quarter of the previous century. The position of sanitary physician was established for the first time in a decree by the Zemstvo of Permskaya Guberniya in 1872 (the first sanitary physician in Russia was Dr. I.I. Molessov). In 1876 there appeared in Moskovskaya Guberniya the first sanitary organization in the form of a sanitary office, directed by the well-known sanitary worker Ye.A. Osipov. Because of the frequent outbreaks of epidemic diseases small-sized although continuously operating disinfecting organizations were established at Odessa in 1874, at St. Petersburg in 1879 and later in other larger cities. These were the municipal disinfecting rooms which proved to be the first practical antiepidemic organizations in our country. There existed in 1917 14 installations of this kind, in St. Petersburg, Moscow, Odessa, Baku, Warsaw, Nizhney Novgorod, Saratov, Tiflis, Poltava, Yalta, Vilnyus, Minsk and Kiev. These installations performed only certain kinds of disinfectant work, and their disinfecting equipment was intended principally for service to hospitals. Other antiepidemic organizations were later organized. Specifically, pasteurization stations were opened in 1886 (during the first years five stations were opened in the entire country).

The Soviet government began ever since the first days of its ascent to power to give great attention to sanitation and antiepidemic service, including the disinfecting installations. It was as early as December 1917 that the Petrograd Council of Workers and Red Army Deputies adopted a resolution to establish at Petrograd an independent disinfecting organization the "Dozbrigady" at which all kinds of disinfecting work would be performed, instead of the municipal hospital disinfecting room which existed in that city. Afterward, similar installations arose in other cities as well. In addition, isolation and permanent control, as well as sanitary points, marine observation stations and other installations were set up. The sanitary permanent control checkpoints were equipped with dry heat and steam disinfecting chambers. Factories for manufacturing these chambers were constructed. Baths already existing in these cities were adapted for the sanitation checkpoints.

These measures were made necessary by the high incidence in the country of smallpox, epidemic typhus, typhus recurrens, typhoid fever, and other diseases. Epidemic typhus was especially widespread. V.I. Lenin addressing the Seventh Congress of Soviets in December 1919 said, ".... in the third scourge still: we are approached upon by lice, epidemic typhus, which mowed down our troops". And further: "Comrades, give attention to this problem. Either lice will vanquish socialism, or socialism lice".

Owing to the tremendous forces of the party, government and the entire people the louse has been vanquished. The disinfecting establishment played a great role in controlling pediculosis at that time. In 1922 the disinfecting brigades that were established in 1918, were reorganized into disinfecting stations and disinfecting points; moreover, the disinfecting offices continued their activities in a number of places.

In proportion to the restoration and development of industry and agriculture (disrupted as a result of the first world war and later by civil war), the financial organs of public health service were improved. The dominant prophylactic trend in Soviet public health service aided the further development of the sanitary and anti-epidemic, as well as disinfection services (which were independent at that time).

The implementation of the second five-year plan for the development of the national economy began in 1933. At that time the national economy was restored, collectivization of agriculture was completed, and industry was developed. The material well-being of the people was improved.

A special service was set up at that time for the organization and implementation of prophylactic and anti-epidemic measures. As of 1 January 1936 there were 1300 disinfecting establishments in the Soviet Union, of which 800 were in cities and approximately 500 in rural areas. They were equipped with 19,756 disinfecting chambers. Around 7000 people worked in the disinfecting establishments.

In 1936 our country entered its third five-year plan. A number of particular dangerous infectious diseases, such as cholera, smallpox and plague had already been eliminated in the USSR by that time. The incidence of other infectious

diseases dropped drastically by that time. A further reduction in the incidence of disease among the population, particularly children's diseases, was foreseen by the third five-year plan. Great attention was given to out-patient treatment as the broadest form of coverage to the population, which assumed a large role in the performance of prophylactic tasks by Soviet public health service.

By 1941 there were in the country 1,760 sanitary and epidemiological stations, 2,288 disinfecting points and detachments, employing 2,826 disinfection instructors (815 rural) and 11,890 disinfection workers (4,715 rural).

The methodological administration of this large network of disinfection establishments is performed by the Central Scientific Research Disinfection Institute (established in 1933) directly put under the Ministry of Public Health USSR in 1938.

During the Second World War (Great Patriotic War) 1941-1945 a strengthening of the sanitary and anti-epidemic service, (including disinfecting establishments) continued, owing to which development of epidemics was successfully prevented (mass infectious epidemics broke out only in places temporarily occupied by the German-fascist troops). Under the conditions of the Great Patriotic War disinfection installations played a greater role in the prophylaxis of infectious diseases than during peacetime.

After reorganization in 1948, all disinfection points and stations were united by the sanitation and epidemiological stations and were included with them under the jurisdiction of the disinfection detachments.

At the present time (1967) there are in the Soviet Union over 4,500 sanitation and epidemiological stations and detachments in hospitals. Included in these establishments there are 3,395 disinfection detachments, of which 2,521 are in rural areas and 844 at republic municipal, district and port sanitary and epidemiological stations. Moreover, there are in 68 of the largest cities independent specialized establishments -- disinfection stations with staffs ranging from 60 - 2,500 persons (Moscow); 71% of the sanitary and epidemiological stations have prophylactic disinfection divisions, which are also concerned with rat control and disinsectization, etc.

About 1000 highly trained specialists, 8000 disinfection instructors and 40,000 disinfection workers are employed in the disinfection establishments, also including the prophylactic disinfection divisions. In addition, a network of special organizations, including several hundred zoologists and biologists with a high degree of training, that are occupied with deratification and disinsectization were set up to check especially dangerous infections.

A number of offices have individual disinfection services. The Ministry of Agriculture has also used a large disinfection service whose job it is to prevent infectious diseases among animals (Polyakov, 1964).

Disinfection in the Soviet Union has therefore been widely developed not only in medicine but in other fields of the national economy as well.

An independent course in disinfection has been introduced at the Department of Microbiology of the Military Medical Academy imeni S.M. Kirov in connection with the demands for antiepidemic service. This course was given by Ya.L. Okunevskiy in Kiev, Baku and Yerevan; three scientific research laboratories were set up which work under the jurisdiction of the division of the Institutes of Epidemiology and Microbiology. The Moscow, Leningrad, Voronezh, Tashkent, Tiflis and several other disinfection stations participate in the scientific research work.

Distinguished Soviet scientists working in the field of prophylactic medicine contributed to the development of disinfection theory and practice: N.F. Famaleya, Ya.L. Okunevskiy, Ya.B. Levinson, Ye.N. Pavlovskiy, P.A. Petrishcheva, A.N. Sysin, L.V. Gromashevskiy, T.Ye. Boldyrev, I.I. Rogozin, I.I. Yelkin, B.I. Gandel'sman, et al.

During the years of the Soviet regime, the disinfection establishments grew both practically and scientifically. A great contribution to the organization of disinfection measures was made by the chief physicians of the municipal disinfection stations and other workers at those installations, for example S.L. Kikodze -- chief physician of the Tiflis disinfection station, Ye.S. Ben'yaminson and I.N. Kudrinskiy, physicians at Moscow municipal disinfection station, G.M. Meyerson, senior scientific fellow at Kiev Institute of Epidemiology and Microbiology, V.V. Yefremov --

chief physician at Leningrad municipal disinfection station, O.N. Magalyan, chief physician at Yerevan disinfection station, and others.

In the control of infectious diseases, the sanitary antiepidemic service has implemented a complex of measures. Isolation of the source of an infection, conclusive disinfection of infected materials in chambers and in a number of localities the organization of current disinfection are performed by the disinfection establishments.

Many disinfection stations at present are reorganizing their work according to the principle of operation used at Leningrad disinfection station, (organized by P.A. Patsanovskiy and Ya.L. Okunevskiy) which has for a number of years already, besides the enumerated functions (hospitalization and disinfection), performed primary registration of the infected sick and persons suspected of suffering from infectious disease. It reports to the district sanitary and epidemiological station the appearance of widespread infection, and performs statistical treatment of materials. The disinfection station has therefore become a municipal center for information stemming from all medical and prophylactic installations. This may later allow primary antiepidemic measures to be more rapidly and completely undertaken.

There are laboratories in nearly all of the disinfection stations of the USSR that maintain bacteriological control of the effectiveness of both 1-shot and running disinfection, as well as endemiological control of the efficiency of disinsectization. The presence of the laboratories allow biologists and other coworkers of the disinfection establishments to perform their scientific and practical work in disinfection, disinsectization, deratification and the organization of disinfection. Such work is performed by the disinfection stations at Moscow, Leningrad, Tiflis, Tashkent and other cities. According to the situation of the disinfection stations, many located at medical and prophylactic institutions (hospitals, confinement homes, etc.) perform biological control not only of current disinfection, but also sterilization with the disinfection stations being granted control of the installation of sterilization at medical and prophylactic organizations since 1966.

Due to such an organization of work by the sanitation and epidemiological services, mandatory hospitalization of

all infectious diseases has been provided. The evacuation of the infected person is generally (70-95%) effected in cities not later than three hours after a sign of the need for hospitalization is received and around six hours in rural areas. In no other country is there a situation with regard to mandatory hospitalization (except where persons suffer from especially dangerous infections) and periods of hospitalization are not provided. This measure is one of the many treatments of the Soviet public health service.

Current disinfection was, even before the revolution, considered one of the most effective prophylactic measures within the focus of an infection. But nevertheless, its organization was not given attention, since the medical and prophylactic establishments were few and the sanitation and antiepidemic service were still embryonic. After the revolution, approximately until the 1940s, the organization and implementation of current disinfection was performed at disinfection establishments, which was not under the force of the latter. In addition, this organization was basically incorrect, because the population alienated itself from its implementation (caring for the sick).

At the present time in the USSR the organization of current disinfection in a number of cities has been assigned to sanitary and epidemiological stations, in others to municipal disinfection stations, and in still others to polyclinics. It should be noted that current disinfection methods organized by polyclinics have considerable advantages in comparison with the organization of their sanitary-antiepidemic and disinfection stations (Kondrat'yev 1957) since they have helped, to a large degree to prevent quarantine diseases (plague, smallpox, cholera, epidemic and recurrent typhus), as well as tuberculosis and several other infections. In accordance with existing regulations, conclusive or 1-shot disinfection in cases of dropsy and intestinal infections and suspicion of these diseases must be performed not later than six hours in cities and 12 hours in rural districts after evacuation of the patient from the focus of infection. Actually, 1-shot disinfection is immediately carried out approximately 50% of the time after isolation of the patient.

Disinfection plays a significant role in railway and other means of transportation (Nikitin, 1956-1964).

Nevertheless, in proportion to the growth of the living standard and increased culture of the peoples of the



Soviet Union, the incidence of infectious diseases is dropping and there is a parallel production in the amount of disinfection treatments.

During the 50 years that the Soviet regime has existed, significant success has been obtained in the field of discovering new means of disinfection (Karaffa-Korbut, 1916; Levashov, 1916). As a supplement to the methods used before 1917 (on slaked lime, chlorinated lime, corrosive sublimate, lysol, iodized carbolic acid, phenol, etc.) one proposed in 1921 chloramine-B and chloramine-T which have high bactericidal properties in relation to the vegetative forms and low activity on the spore forms of microorganisms (Okunevskiy, 1936). To impart sporicidal properties to chlorine-containing preparations the addition of ammonium salts is recommended to their solutions (Kovalev, 1947, 1954, and others). In the 1940s calcium hypochlorite was proposed as a bactericide. Chlorobenzene chloramine, a new preparation, was introduced as a disinfectant in 1955 (Ye.N. Nertsalova, 1957).

Other compounds were also studied which contain a high percentage of active chlorine. Manufactured hydantoic and cyanuric acids, which display sporicidal properties, are of the greatest interest among this group of compounds. Belonging to these compounds are dichlorohydantoin, mono- and dichlorodimethylhydantoin (Chenchikova, 1961), trichloroisocyanuric and dichloroisocyanuric acids. Potassium and sodium salts of dichloroisocyanuric acid are recommended for disinfectants because the latter are weakly soluble in water (Sokolova, 1952, 1965 and others). N-chlorosuccinimide possesses strong bactericidal properties (Lebedeva and Verkhovtova, 1967).

A great deal of attention was given to the search for bactericides among phenol derivatives. The most effective one of these turned out to be butylchlorophenol (Petro-pavlovskaya, 1948), oxydiphenyl [?] (Bekker, 1947), sodium salts of pentachlorophenol (Gandel'sman and coauthors, 1948), benzylchlorophenol, hexachlorophene (Sukhareva and coauthors, 1957). 1-chloro-D-naphthol was suggested (Alekseyeva and Shavyrina, 1959), which has selective bactericidal properties in relation to the microbacteria tuberculosis (it being over ten times more effective than chloramine). Research has shown that benzylchlorophenol and phenoltrichloroacetate have analogous properties (Kamenov, 1966).

In connection with the widespread use of surface-active agents in the national economy, ordinary ammonia

bases have been investigated: tetraammoniumalkylpyridine bromide, paraalkylpyridine bromide, alkyl dimethylbenzylammonium chloride and a number of other compounds (Skvorsova, 1965; Shumayeva, 1966, et al.).

A study has been made in recent years of the bactericidal properties of various iodine compounds. It has, for instance, been shown that iodine trichloride in the form of a 1% solution kills spores in several minutes. It has been determined that the bactericidal action of iodine in a mixture with surface-active agents is significantly increased. Mixtures of this kind are called iodophores (phore-carrier). Polyvinylpyrrolidone is most frequently used as a surface-active agent; a 1% solution of iodophore is used to disinfect the hands of a surgeon, the operation stage and as a disinfectant in the food industry. Similar concentrations contain up to 35% iodine. The advantage of iodophores above iodines lies in the fact that they do not produce allergic reactions and possess stronger bactericidal properties (Skala and coauthors, 1965).

The bactericidal properties of lactones are being investigated. The greatest amount of attention given to this group of compounds has centered on  $\beta$ -propyllactone which has strong virucidal, bactericidal and fungicidal activity. It is used for sterilization, as well as for disinfection in foci of infection. It is highly effective in the form of aerosols. Among the positive characteristics of  $\beta$ -propyllactone is its ability to destroy all microorganisms when introduced into a liquid being sterilized, breaking down the process and converting itself to harmless substances (Bazhinov and Kamorskiy, 1960; Mazurova and Tseytlin, 1965). Sodium metasilicate has been used in the Armenian SSR (Shakhbazyan, 1963).

The explanation of disinfectants and elaboration of methods using different compounds in gaseous form are being carried out. Ethylene oxide and methyl bromide have particularly been suggested for these purposes in the USSR (Prishchep, 1964). Substantial attention has been given to the elaboration of methods of applying aerosols for disinfection and disinsectization (Yarnykh, 1962; Tsetlin and Edel'shteyn, 1965).

For many years physical methods of disinfection have been developed, for example utilizing ultraviolet rays (Frank, 1958; Neyshtadt, 1955; R.M. Ginzburg and Vashkov, 1966),

high-frequency sound (Karaseva and Fedotova, 1965), ultrasound (Elpiner, 1959), and iodizing radiation (Tuman'yan and Khrushchev, 1957).

The improvement of disinfection chambers and apparatus has continued (Mikhel'son, 1947, et al.).

A new method of disinfecting well water has been suggested for prophylaxis of intestinal diseases. A ceramic cartridge having a specified corrosivity is filled with calcium hypochlorite, closed with a ceramic stopper and dropped into the well (Molozhavaya and coauthors, 1957). The chlorine diffuses through the pores of the cartridge, thereby disinfecting the well water; a cartridge remains active 3-4 weeks, after which it is refilled with calcium hypochlorite. A bactericidal soap containing hexachlorophene has been developed and is being manufactured under the name "Gigiyena" (Hygiene) by "Svoboda" (Free) in Moscow. Daily use of this soap imparts a bactericidal property to the skin of one's hands. Work has successfully been done on conferring antibacterial properties to various materials used in medicine and in other branches of the national economy (Fedosova, 1957; Shcheglova, 1963). Particularly, these properties have been obtained for transporting materials, textiles, surgical dressings, medical resins, as well as surfaces that may be covered with bactericidal paint and varnishes, which retain their bactericidal properties for many years.

We have cited only a few of the means and methods which have been proposed throughout the last 50 years and have been applied in practice.

Consequently, these by far incomplete data do nevertheless testify to the significant achievements attained during the past 50 years both in the organization of disinfection services as well as in the search for new methods and disinfectants.

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(Submitted to Editors 25 April 1967)

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CSO: 1870-N